Traffic Level-of-Service Definitions for Highways and Arterial Roadways

Level-of-Service	Definition
A	**EXCELLENT.** Completely free-flow conditions. Vehicle operation is virtually unaffected by the presence of other vehicles. Minor disruptions are easily absorbed without causing significant delays.
B	**VERY GOOD.** Reasonably unimpeded flow; the presence of other vehicles begins to be noticeable. Disruptions are still easily absorbed, although local deterioration in LOS will be more obvious.
C	**GOOD.** The ability to maneuver and select an operating speed is clearly affected by the presence of other vehicles. Minor disruptions may be expected to cause serious local deterioration in service, and queues may form behind any significant traffic disruption.
D	**FAIR.** Conditions border on unstable flow. Speed and the ability to maneuver are severely restricted due to traffic congestion. Only the most minor disruptions can be absorbed without the formation of extensive queues and deterioration of service to LOS F.
E	**POOR.** Conditions become unstable. Represents operation at or near capacity. Any disruption, no matter how minor, will cause queues to form and service to deteriorate to LOS F.
F	**FAILURE.** Represents forced or breakdown flow. Operation within queues is unstable and characterized by short spurts of movement followed by stoppages.

Effects on traffic at 215 intersections were estimated using procedures outlined in the *Highway Capacity Manual* (TRB 2000) of the Transportation Research Board. The analysis identified existing operating conditions at intersections and projected conditions under the future No Build and Build Alternatives in areas that would be affected by the fixed guideway system.

Traffic effects were determined by comparing changes in level-of-service (LOS) under the No Build Alternative with the Build Alternatives in 2030. An effect was considered to exist when the Project would cause any of the following conditions during either the a.m. or p.m. peak hours:

- LOS declines from D or better to E or F
- LOS declines from E to F
- The No Build Alternative LOS is E or F and the average vehicle delay increases

Where appropriate, measures to lessen or mitigate the Project's effects are identified. For more detail on the methods used to analyze transportation effects, see the Transportation Technical Report (RTD 2008a).

3.2 Existing Conditions and Performance

This section discusses existing transportation conditions in the study corridor. The discussion includes existing travel patterns and the conditions and performance of public transit, streets and highways, freight movement, parking, and the bicycle and pedestrian network. Unless otherwise noted,

Information presented in this section primarily involves islandwide travel conditions and performance. Islandwide data reflect traffic and conditions for the study corridor since this corridor dominates in terms of total transportation demand. For example, 83 percent of both islandwide daily and peak-period work-related transit trips originate within the study corridor. The study corridor also attracts 90 percent of total islandwide daily transit trips and 94 percent of peak-period work-related transit trips.

- **Peak Express** routes serve predominantly home-to-work trips by connecting neighborhoods to employment centers. Service is provided during peak periods and in the peak direction. Examples include Routes 81, 85, and 93. Feeder service to TheBoat is a subset of Peak Express. Examples include Routes F11, F12, and F13.

Most bus routes operate seven days a week, including holidays. Passenger amenities include approximately 980 passenger shelters and 2,400 benches. The Transportation Technical Report (RTD 2008a) provides detailed information on the system, including schedules and routes.

TheHandi-Van Service

TheHandi-Van is the City's paratransit service for persons who are eligible according to the Americans with Disabilities Act of 1990 or for persons certified by the City. The service area, days, and hours of operation are the same as TheBus. Trips must be reserved 24 hours in advance.

TheBoat Service

In September 2007, the City began offering a commuter ferry service between West O'ahu (Kalaeloa Harbor) and Downtown Honolulu (Aloha Tower Marketplace). TheBoat service operates each weekday, with three trips in the morning and three trips in the evening.

To complement TheBoat, local shuttle bus service connects ferry terminals with several locations in West O'ahu and Downtown Honolulu, as well as UH Mānoa and Waikīkī.

Fleet

TheBus fleet consists of 540 buses. This includes 72 vehicles that are 60-foot articulated buses, of which 10 are hybrid; 431 vehicles that are 40-foot buses; and 37 vehicles less than 40 feet long. TheHandi-Van vehicle fleet contains 129 vehicles.

TheBoat service is provided by two 149-passenger vessels chartered by the City. The vessels are passenger-only and do not accommodate vehicles.

Fare Structure

Fare structures for the TheBus and TheBoat are the same and are established by the City Council. Current fares were set in 2003. Table 3-4 provides information on the current breakdown of ridership by fare type. At 41 percent of total ridership, monthly adult pass holders predominate, followed by senior/disabled riders at 27 percent. Considering the various discounts available, the average fare paid is $0.77 per person trip. For TheHandi-Van, every cardholder and companion must pay a fare of $2.00 per person per trip.

Transit Facilities

Existing transit facilities include maintenance and storage facilities, park-and-ride lots, transit centers, major transfer points, and two dedicated bus-only roadways (Hotel Street between River and Alakea

Table 3-4 TheBus and TheBoat Fare Structure—2007

Fare Category	Current Fare	Percentage of Riders by Fare
Adult	$2.00	12%
Youth	$1.00	5%
Senior/Disabled	$1.00	27%
Transfer (1 per trip)	$0.00	7%
Monthly Adult Pass	$40.00	41%
Monthly Youth Pass	$20.00	6%
Monthly Senior/Disabled Pass	$5.00	(included with Senior/Disabled)
Annual Adult Pass	$440.00	(included with Monthly Adult Pass)
Annual Youth Pass	$220.00	(included with Monthly Youth Pass)
Annual Senior/Disabled Pass	$30.00	(included with Senior/Disabled)

Percentages do not add up to 100% because the table does not include minor fare categories such as Visitor Pass.

Source: 2007 City and County of Honolulu records.

Mode of Travel

Table 3-8 also provides mode share information for islandwide daily trips in 2007 and under 2030 No Build conditions. For trips made by residents, there would be virtually no change in shares for the identified travel modes: private automobile, transit, and bicycle and walk. For trips made by visitors, the share by private automobile under No Build conditions would increase from 32 to 37 percent. The transit share would be unchanged, and minor changes are estimated for taxi and tour bus. However, the bicycle and walk share would decrease from 45 to 38 percent as more auto-oriented tourist destinations, such as Ko ‘Olina, are developed over time.

Vehicle Miles Traveled, Vehicle Hours Traveled, and Vehicle Hours of Delay

Table 3-9 shows the systemwide VMT, VHT, and VHD in the study corridor for 2007 and the 2030 No Build Alternative. Under 2030 No Build conditions, approximately 13.6 million VMT per day are projected in the transportation system, including major freeways, highways, arterials, and collectors. This would be an increase of approximately 17 percent (or 2 million miles) over 2007 conditions.

Table 3-9 Daily Vehicle Miles Traveled, Vehicle Hours Traveled, and Vehicle Hours of Delay—2007 and 2030 No Build Alternative

Alternative	Daily VMT	Daily VHT	Daily VHD
2007 Existing Conditions	11,581,000	334,000	74,000
2030 No Build	13,583,000	415,000	106,000
% Change from 2007	*17%*	*24%*	*43%*

VHT is expected to increase by 24 percent by 2030 compared to 2007 levels. Delay would increase by 43 percent. VHT and VHD would increase at a higher rate than VMT because as roadway facilities become oversaturated, travel times through the affected sections would increase dramatically.

Reverse Commute Market

Reverse commute trips originate in central areas and are destined to outlying and more suburban locations. Similar to current conditions, the No Build Alternative would have two-way transit service along major travel corridors, thereby providing opportunities for reverse commute bus riders. However, the effectiveness of the service would be compromised by characteristics such as reduced overall bus travel speeds.

Service to Transit-Dependent Households

Bus service under the No Build Alternative would provide access to areas with high concentrations of transit-dependent households. Compared to 2007 conditions, some increases in transit travel times are projected for travel markets involving transit-dependent households. One example is between Pearlridge and Downtown Honolulu. Other travel markets would experience small reductions in transit travel times.

In 2030 under the No Build Alternative, even with ORTP planned improvements, the key measures of transit reliability, accessibility, mobility, and equity would all be worse than today.

3.3.2 Effects on Transit

This section provides information on the effects of the No Build Alternative on transit, including travel times, service reliability, and ridership resulting from anticipated limitations of the roadway network.

Transit Speed

In general, transit travel times during the a.m. two-hour peak period (6:00 to 8:00 a.m.) would be longer under the 2030 No Build Alternative when compared to 2007 due to generally slower transit speeds. Figure 3-5 shows system-level historic transit speeds as well as projected speeds under the No Build Alternative. Table 3-10 shows estimated

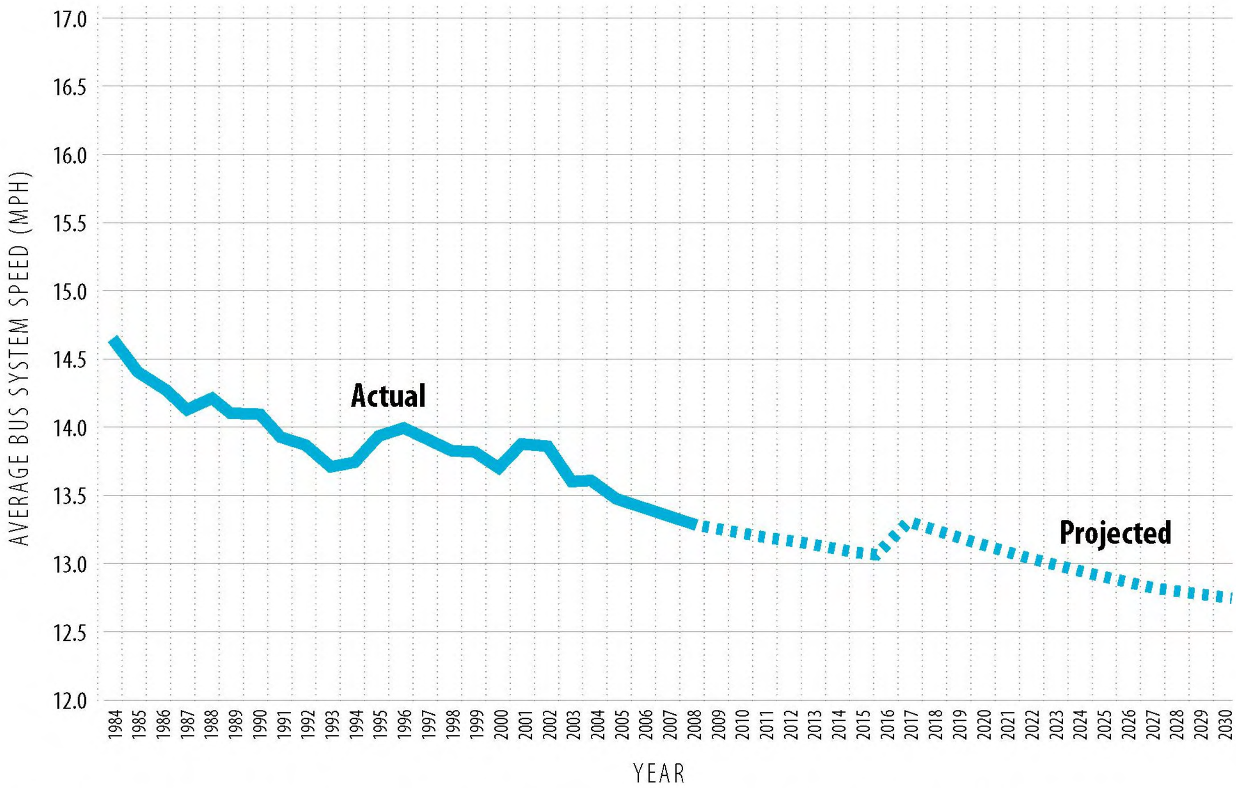

Figure 3-5 TheBus Average Operating Speeds in Miles per Hour—Historic and Projected under 2030 No Build Alternative

Table 3-10 A.M. Peak Period Transit Vehicle Speeds (in miles per hour)

Alternative	Kapolei to Downtown	`Ewa to Downtown	Waipahu to Downtown	Mililani Mauka to Downtown	Pearlridge Center to Downtown	Downtown to Ala Moana Center	Waipahu to Waikiki
2007 Base Year	19	15	19	20	15	13	17
2030 No Build	19	15	19	18	13	10	17
2030 Salt Lake	29	23	33	30	31	24	25
2030 Airport	28	22	32	30	29	24	25
2030 Airport & Salt Lake	29	23	33	31	31	24	25

changes in transit speeds for several locations in the corridor. Slower speeds are attributable to increased traffic along streets and highways on which buses operate. The temporary increase in transit speeds in 2018 is attributable to planned implementation of extended HOV lanes on the H-1 Freeway and improved transit operations in the zipper lane.

Some transit travel times, such as from Waipahu to Waikīkī and Mililani Mauka to Downtown, are projected to improve under the No Build Alternative. These trips would take advantage of extended HOV lanes on the H-1 Freeway, improved operations of the zipper lane (assumed to be limited to three or more-occupant vehicles in the year 2030), and/or the proposed Nimitz Flyover facility (which would give priority to HOVs and transit vehicles).

Transit Ridership

Transit boardings under the No Build Alternative are expected to keep pace with population growth and increase over 2007 existing conditions by approximately 25 percent (Table 3-11). No major increases in the transit share of total travel are projected for the No Build Alternative.

Table 3-11 Changes in Total Daily Transit Boardings and Trips—2007 and 2030 No Build Alternative

Alternative	Total Transit Boardings	Total Transit Trips
2007 Existing Conditions	251,000	184,000
2030 No Build	314,000	226,000
% Change from 2007	*25%*	*23%*

Although some increases in bus services would occur under the No Build Alternative, a review of route-specific demand and service levels for 2030 indicates that bus capacity would be exceeded for several routes. In some cases the demand per bus trip would be more than twice the seating capacity.

Adding substantial passenger capacity with more buses is not feasible in some key locations along the system because of roadway capacity constraints. For example, only certain streets serving Downtown can be used by buses (other streets are either too narrow or do not connect efficiently with other key transit roadway corridors), and those are already at or very near capacity during peak hours. Short blocks, in particular, and narrow rights-of-way Downtown limit the number of new buses that can be added to the system. Outside of Downtown, other choke points for buses include the Ala Moana Center area, Waikīkī, and Pearl City.

Transit Reliability

In addition to the estimated increase in transit travel times, transit reliability under the No Build Alternative would likely worsen compared to existing conditions. This is due to projected increases in congestion and a longer duration of unstable traffic flow expected during the a.m. two-hour peak period. Operating conditions, such as missed trips and bus turnbacks, are expected to worsen. Of particular concern is the reliability of longer-distance service connecting the emerging population centers in West O‘ahu with major destinations such as Downtown.

Access to Transit Service

With the No Build Alternative, access to transit services would be generally similar to current characteristics. New transit centers would be built at five locations to allow transfers between TheBus routes. One additional park-and-ride facility would be built at the Middle Street Intermodal Transportation Center.

Transfers

The estimated rate of transfers under the No Build Alternative would be 39 percent (or 1.4 bus rides or segments per transit trip). This rate is close to the 37 percent transfer rate in 2007 (or 1.4 bus rides or segments per transit trip). The transfer rate would reflect that the bus route structure under the No Build Alternative would be generally similar to that in 2007.

Comfort and Convenience

With the No Build Alternative, additional bus service would be provided on some routes. Given the reliance on buses, most of which would continue to operate in mixed traffic, transit riders would be subject to service delays and long trip times for several travel markets. Riders who have to stand would be subject to frequent stop-and-go vehicle movements.

3.3.3 Effects on Streets and Highways

This section discusses the effects of the No Build Alternative on streets and highways and includes future highway volumes and travel times.

Screenline Volumes and Operating Conditions

Under the No Build Alternative, vehicular traffic volumes on major roadway facilities in the study corridor are projected to increase from existing conditions. Due to the high rate of population

Table 3-14 Vehicle Miles Traveled, Vehicle Hours Traveled, and Vehicle Hours of Delay—2030 No Build and Build Alternatives

Alternative	Total			Percent Change from No Build		
	Daily VMT	Daily VHT	Daily VHD	Daily VMT	Daily VHT	Daily VHD
No Build	13,583,000	415,000	106,000	n/a	n/a	n/a
Salt Lake	13,096,000	385,000	84,000	-4%	-7%	-21%
Airport	13,086,000	385,000	82,000	-4%	-7%	-23%
Airport & Salt Lake	13,103,000	386,000	83,000	-4%	-7%	-22%

Under congested conditions, even small reductions in traffic volumes can show large reductions in delay.

Reverse Commute Markets

Improved access to West O'ahu communities would also address reverse commute markets. Reverse commute trips originate in central areas and are destined to outlying and more suburban locations.

The fixed guideway service provided under the Build Alternatives would support and reinforce land use plans associated with O'ahu's planned "second city" in Kapolei. With an almost four-fold increase in employment estimated by 2030 for Kapolei, the quick and direct access provided by the fixed guideway system from PUC Development Plan area locations (e.g., Downtown and Kaka'ako) would help address the demand of future reverse commute markets. These markets include existing and planned local government offices and the future UH West O'ahu campus. Based on transit travel forecasts, about 20 percent of fixed guideway ridership during the a.m. two-hour peak period would be in the 'Ewa-bound direction, which demonstrates that the Project supports the goal of improving access to planned development and a second urban center.

With quick transit access provided to emerging employment centers, the Build Alternatives support enhanced transportation equity. Of the reverse commute transit trips with destinations in 'Ewa and Kapolei during the a.m. two-hour peak period, 51 to 52 percent originate from low-income communities.

Service to Transit-Dependent Households

Under the Build Alternatives, transit travel time benefits would occur for several communities with high concentrations of transit-dependent households (Figure 3-7). The transit-dependent communities are those with higher than average numbers of households without vehicles or residents who are unable to drive. There would be substantial travel time benefits for transit-dependent communities such as Waipahu, West Loch, Waikīkī, Chinatown, and Makakilo.

3.4.2 Effects on Transit

This section describes the effects of the Build Alternatives on various transit factors, including mobility, access, reliability, and equity.

The Build Alternatives would benefit the overall transportation system, enhancing the key measures of transit reliability, accessibility, mobility, and equity.

Transit Speed

Transit riders would experience substantially reduced travel times under the Build Alternatives compared to existing conditions and the No Build Alternative. Shorter travel times reflect faster systemwide transit speeds. Bus speeds have gradually declined over the past several years and would continue to decline under the No Build Alternative as a result of growth in traffic congestion and the lack of exclusive right-of-way

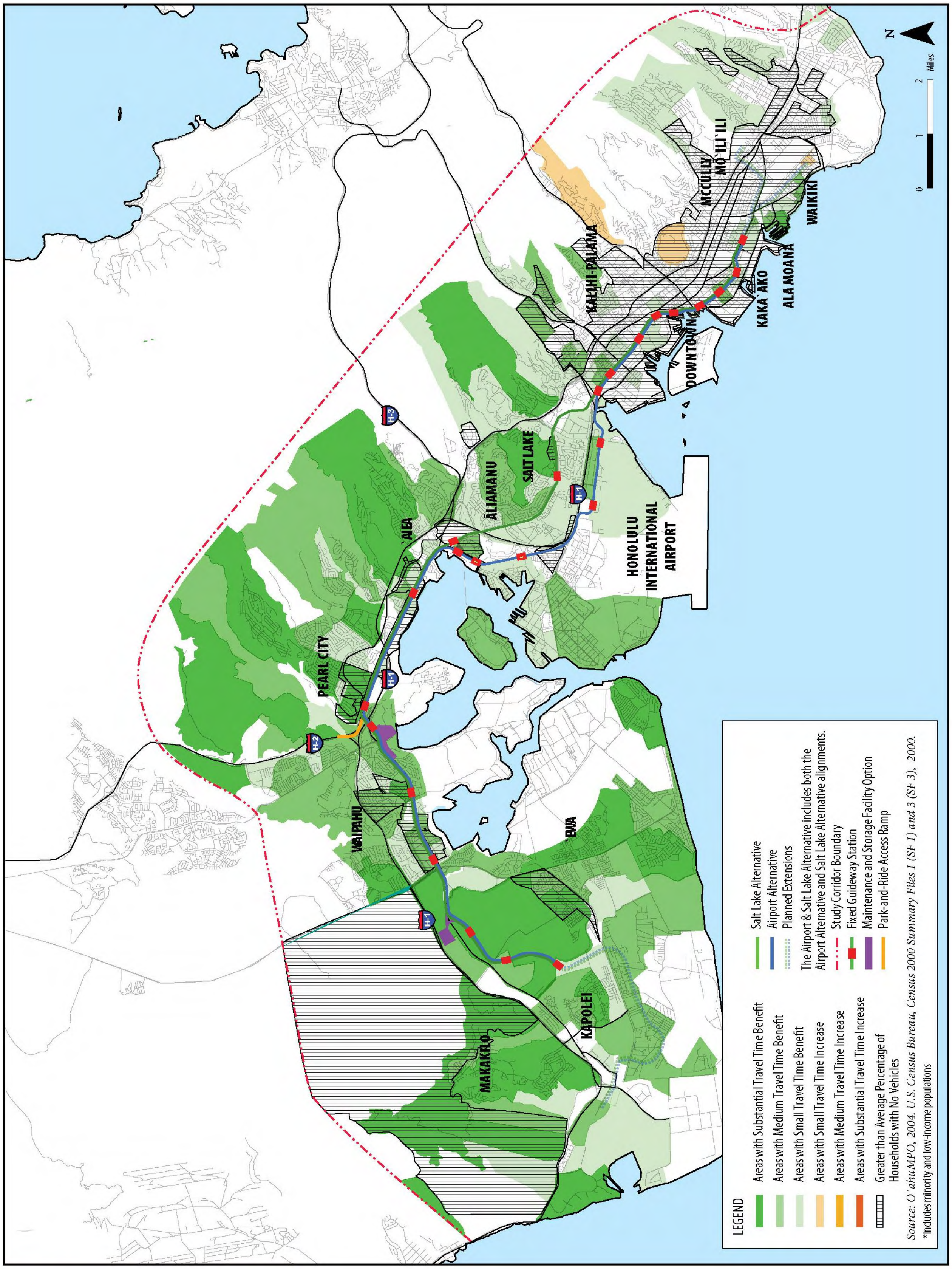

Figure 3-7 Transit Dependent Households

for transit vehicles. However, the fixed guideway operations would provide faster service compared to bus-only operations. Figure 3-8 compares system-level transit speeds for the No Build and Build Alternatives. Table 3-10 lists transit speeds for the No Build and Build Alternatives at selected locations. As a result of the increased transit speeds, major reductions in transit travel times would occur for several major markets, such as between Downtown Honolulu and developing areas in ‘Ewa.

Under any of the Build Alternatives, average travel times on transit would improve dramatically, enhancing overall mobility and accessibility. In some cases, transit travel times would be half of what they are today.

Figure 3-9 shows 2007 and 2030 travel times between selected locations. This information represents the time required to complete a trip from origin to destination and assumes that at least a portion of the trip would be made on the fixed guideway system. Travel-time information for 2030 is presented for the No Build Alternative and the Build Alternatives.

As demand increases after the fixed guideway system is fully operational, service would gradually be expanded with more frequent and longer trains. This would cause the overall average transit speed to continue to increase. Trips to and from Mililani and Waikīkī, which are not along the alignment, would also benefit from reduced travel times when using the guideway. Station-to-station travel times are shown in Table 3-15. Since the fixed guideway system would operate independently from traffic, these travel times would be the same at all times of the day, offering certainty and reliability to riders. For example, the travel time between the East Kapolei and UH West O‘ahu Station would only be two minutes. The travel time from East Kapolei to Pearlridge Station would be the sum of the travel times in between, or 18 minutes along a heavily traveled portion of the study corridor.

Transit Ridership

Transit Ridership—Systemwide

Table 3-16 shows projected daily transit ridership for the No Build and Build Alternatives. Ridership numbers are presented in terms of fixed guideway boardings and total transit boardings. Daily transit boardings for the Build Alternatives would increase up to 43 percent over the No Build, depending on the alternative. Service frequency would be lower on the Airport & Salt Lake Alternative, so slightly fewer fixed guideway boardings are projected for this alternative.

Station and Link Volumes

Figure 3-10 shows the number of fixed guideway boardings (passengers getting on) and alightings (passengers getting off) that would occur at each station during the a.m. two-hour peak period in each direction. The Pearl Highlands Station would have the highest number of boardings in the a.m. two-hour peak period, and the Ala Moana Center Station would have the highest number of alightings and total passenger activity (boardings plus alightings).

Figure 3-11 shows the passenger volumes on guideway trains between each station during the a.m. two-hour peak period. The location of the highest link volume would vary by alternative: between Ala Liliko‘i and Middle Street for the Salt Lake Alternative, between Aloha Stadium and Pearl Harbor for the Airport Alternative, and between Middle Street and Kalihi for the Airport & Salt Lake Alternative.

The maximum peak direction (Koko Head) volume during the a.m. two-hour peak period would be about 11,950 passengers in 2030. This is close to the fixed guideway system’s currently planned minimum capacity of 12,000 passengers per direction for a two-hour period, making it possible demand

Table 3-15 Station-to-Station Travel Times

Station to Station		Travel Time Between Stations (in minutes, including dwell time)			
		Salt Lake Alternative	Airport Alternative	Airport & Salt Lake Alternative	
				Salt Lake Alignment	Airport Alignment
East Kapolei	UH West O`ahu	2	2	2	2
UH West O`ahu	Ho`opili	4	4	4	4
Ho`opili	West Loch	2	2	2	2
West Loch	Waipahu TC	3	3	3	3
Waipahu TC	Leeward CC	2	2	2	2
Leeward CC	Pearl Highlands	1	1	1	1
Pearl Highlands	Pearlridge	4	4	4	4
Pearlridge	Aloha Stadium SLB	2	n/a	2	n/a
Aloha Stadium SLB	Ala Liliko`i	4	n/a	4	n/a
Ala Liliko`i	Middle Street	4	n/a	4	n/a
Pearlridge	Aloha Stadium KH	n/a	3	n/a	n/a
Pearlridge	Arizona Memorial	n/a	n/a	n/a	3
Aloha Stadium KH	Pearl Harbor	n/a	2	n/a	n/a
Arizona Memorial	Pearl Harbor	n/a	n/a	n/a	2
Pearl Harbor	Airport	n/a	3	n/a	3
Airport	Lagoon Drive	n/a	2	n/a	2
Lagoon Drive	Middle Street	n/a	2	n/a	2
Middle Street	Kalihi	2	2	2	2
Kalihi	Kapālama	2	2	2	2
Kapālama	Iwilei	2	2	2	2
Iwilei	Chinatown	1	1	1	1
Chinatown	Downtown	1	1	1	1
Downtown	Civic Center	1	1	1	1
Civic Center	Kaka`ako	1	1	1	1
Kaka`ako	Ala Moana	2	2	2	2
Total Travel Time		**40**	**42**	**40**	**42**

CC = Community College KH = Kamehameha Highway SLB = Salt Lake Boulevard TC = Transit Center

Table 3-16 Daily Transit Boardings and Trips for 2030 No Build and Build Alternatives

Alternative	Fixed Guideway Boardings	Total Transit Boardings	Total Transit Trips
No Build	n/a	314,000	226,000
Salt Lake	88,000	449,000	270,000
% Change from No Build		*43%*	*19%*
Airport	95,000	450,000	273,000
% Change from No Build		*43%*	*21%*
Airport & Salt Lake	93,000	446,000	272,000
% Change from No Build		*42%*	*20%*

Boardings represent the total number of times someone gets on a transit vehicle, whereas a trip can include transfers.

could exceed capacity for a short time during the peak period. While this is not anticipated to be a major problem based on forecast ridership, should higher passenger volumes be realized, the system will be designed to be able to provide substantially higher capacity by adding vehicles or reducing headways. Such operational adjustments would be evaluated as the system approaches the planned capacity toward 2030.

Figure 3-12 shows the number of daily fixed guideway boardings and alightings projected for each station. For all-day travel, the Ala Moana Center Station would experience the highest

Substantial increases in transit share would also occur for travel markets not directly served by the fixed guideway. For example, the transit share of the Waipahu to Waikīkī market would increase from 8 percent under No Build to between 25 percent and 26 percent under the Build Alternatives. This increase in transit share is related to faster systemwide transit speeds and improved access to the fixed guideway system due to more reliable feeder bus service.

With the Build Alternatives, public transit's share of total travel would increase. For several travel markets, transit's share of a.m. two-hour peak-period commute-to-work trips would double.

Transit Reliability

Transit service reliability is highly influenced by the number of vehicles operating in exclusive right-of-way. Under the No Build Alternative, express bus routes would operate in the a.m. and p.m. zipper lanes and HOV lanes. However, these lanes would not be exclusively reserved for transit operations.

The No Build Alternative does not provide any exclusive right-of-way for transit vehicles along major highways that could enhance transit service reliability.

Operating transit vehicles on a fixed guideway would provide substantially higher transit service reliability compared to No Build conditions.

Since the fixed guideway vehicles would be completely separated from roadway traffic operations, the Build Alternatives would provide substantially higher transit service reliability compared to the No Build Alternative. This reliability would not deteriorate over time, even with projected population and employment growth in the study corridor. The reliability of fixed guideway vehicles would be better than the reliability of transit vehicles operating on increasingly congested highways.

The bus network would also be restructured to provide access from surrounding communities to the fixed guideway with more frequent bus service. Bus routes serving guideway stations would typically be shorter and would operate in less congested residential communities. These operations would help maintain service reliability compared to operations of longer-distance routes.

Providing this separation between the guideway system and general traffic would address the gradual deterioration of service reliability. Bus service on Oʻahu has been experiencing a decline in service reliability, and this decline is predicted to continue under 2030 No Build conditions.

Access to Fixed Guideway Stations

With the Build Alternatives, overall accessibility to transit would be enhanced. The Build Alternatives would attract substantial ridership via local bus access and from people walking to stations (Table 3-18). Bus and walk access to stations would account for approximately 85 percent of total trips in the a.m. two-hour peak period. Although some

Table 3-18 Mode of Access to Fixed Guideway Stations

Alternative	Daily Persons Trips using Guideway Stations by Mode								
	Walk		Bus		Kiss-and-Ride		Auto		Total
	Volume	% Share	Volume	% Share	Volume	% Share	Volume	% Share	
Salt Lake	13,900	16%	61,190	69%	3,210	4%	10,080	11%	88,380
Airport	16,480	17%	65,190	68%	3,290	3%	10,730	11%	95,690
Airport & Salt Lake	16,330	18%	63,130	68%	3,220	3%	10,220	11%	92,900

Numbers do not equal 100 percent due to rounding.

drive access is projected at outlying stations, such as East Kapolei, the predominant access would be by local bus and walking. For those leaving stations in the a.m. two-hour peak period, egress via walking dominates, particularly at stations with large employment concentrations. Escalators and elevators would be available at each station.

Access to stations would also be enhanced by accommodating bicyclists and pedestrians. Several stations would be located at or near existing or planned bicycle facilities. Each station would have facilities for parking bikes, and each guideway vehicle would be designed to accommodate bicycles during off-peak hours. Sidewalks and crosswalks are currently available at stations or would become available as streets and sidewalks are built in developing areas.

The dominance of local buses and walking to the fixed guideway system indicates that overall accessibility would be broad. This is especially important for riders who do not have access to automobiles.

Transfers

A major feature of O'ahu's existing transit service is reliance on transit centers as focal points of activity. The transfer rate in 2007 was 37 percent, and the estimated rate for the 2030 No Build Alternative is 39 percent, which equals about 1.4 bus rides or segments per transit trip.

With any of the Build Alternatives, the rate of transfers would be higher than under the No Build Alternative due to proposed changes in local bus service to maximize access to the fixed guideway system. Some existing routes, including peak-period express service, would be altered to avoid duplication with the fixed guideway system. Some local routes would also be rerouted or reclassified as feeder buses to provide better service to the nearest fixed guideway station. The projected rate of transfers would range from 64 to 67 percent, depending on the alternative, which is about 1.7 transfers per trip.

Because of the high frequency of the fixed guideway service (three-minute headways between trains during peak periods), riders transferring from buses to the fixed guideway would experience minimal wait times. Riders transferring from the guideway service to buses would benefit from improved frequencies on existing bus routes serving stations. Also, several new routes with high frequencies would be provided as feeders to the guideway system. Since these routes would primarily operate in residential areas, they would provide greater reliability versus routes operating along congested arterials. Riders transferring from rail-to-bus would also benefit from coordinated transfers between trains and buses, thereby minimizing wait times.

The use of local bus feeder service also makes the fixed guideway system highly accessible, particularly for people dependent on transit or who would prefer not to drive to stations. The fixed guideway system would facilitate the reorientation of the bus system and improve transit service beyond the immediate vicinity of the study corridor.

To facilitate transfers, fixed guideway stations and other major transit hubs would provide conveniences such as covered waiting areas. Off-vehicle fare collection would reduce travel and wait times.

Comfort and Convenience

As described in Chapter 2, the fixed guideway system's service frequencies (every three to ten minutes) and hours of operation (between 4 a.m. and midnight) would minimize wait times and thus provide major conveniences to riders. The service frequency and train *consists* (the number of cars per train) would also be designed to better meet peak-period/peak-direction rider demand. Comfort for riders would be enhanced by station amenities, including covered waiting areas and seats.

Operation of the fixed guideway in exclusive right-of-way would improve convenience. For riders who stand, the guideway service would also provide increased safety compared to frequent stop-and-go travel that occurs on buses that travel in mixed traffic on uneven roadway surfaces. Because the station platforms would be at the same level as the vehicles, this would accommodate quick and easy boardings for all patrons, especially those in wheelchairs or with strollers.

Transit User Benefits

Transit user benefits represent the amount of transit travel-time savings a user would experience with a given transit alternative compared to the No Build Alternative. This section discusses the transit-user benefits of the Build Alternatives compared to the No Build Alternative. Transit user benefits is an effective way to quantify the four key goals of the Project.

The main factor in determining benefits is travel time. User benefits are measured in minutes and are a summary measure that incorporates travel-time changes for all modes.

Positive Attributes of a Fixed Guideway System

Research indicates that positive attributes (both perceived and real) are associated with the use of a fixed guideway system, which make the system more attractive than general bus transit. These benefits include such things as improved safety, security, visibility, ease of use, comfort, and reliability. These factors or attributes are not captured by the standard travel demand forecasting process. To account for these attributes in this user benefit analysis, FTA has approved an additional factor equivalent to a 14.5-minute savings of in-vehicle time. The factor was incorporated for riders taking the fixed guideway only. A 5.5-minute savings of in-vehicle time was incorporated for riders taking feeder buses to the fixed guideway.

This factor is based on information from several regions where existing rail transit service has been a part of the transit system and where these systems have been recently surveyed.

Transit User Benefits—Selected Major Travel Markets

Transit user benefits have been estimated for various travel markets and at the geographic level. With the Build Alternatives, it is estimated that approximately 50,000 hours of transit travel times per weekday would be saved. Greater use of the transit system, higher transit speeds, and the other attributes noted previously would contribute to these user benefits.

Table 3-19 Estimated Transit User Benefits Resulting from 2030 Build Alternatives

Key Transit Market*	Salt Lake Alternative	Airport Alternative	**Airport & Salt Lake Alternative**
Work trips to Downtown Honolulu	3,840	3,680	3,590
Visitor trips from Waikīkī	1,050	1,450	1,490
Other trips to Downtown	340	310	240
Work trips to Waikīkī	2,830	2,760	2,730
Work trips to Kalihi	1,640	1,570	1,540
School trips to UH Mānoa	2,980	2,900	2,900
Work trips to Kaka`ako	1,400	1,360	1,330
Work trips Mō`ili`ili	1,290	1,250	1,220
Work trips from `Ewa	2,620	2,680	2,610
Work trips from Kapolei	1,420	1,460	1,400
Work trips from Waipahu	1,860	1,910	1,860
Work trips from Mililani	1,380	1,450	1,410
Subtotal	**22,650**	**22,780**	**22,320**
Other	26,330	29,120	27,850
Total	**48,980**	**51,900**	**50,170**

Source: O'ahuMPO Travel Demand Forecasting Model.
*Except for *Visitor trips from Waikīkī*, the markets involve home-based travel.

The user benefits, expressed in terms of saved hours per day, can also be identified for specific transit travel markets. Table 3-19 shows estimated daily savings for several markets on O'ahu. These savings would range from approximately 240 to 340 hours per day (for Home-Based Other trips destined to Downtown) to almost 3,590 to 3,840 hours per day (for Home-Based Work trips to Downtown Honolulu). In addition, there are transit travel-time benefits for work trips from 'Ewa and Kapolei, both planned development areas. The estimated cumulative savings of approximately 22,320 to 22,780 hours per day represents just under one-half of the approximately 50,000 estimated total daily user benefits that would result from the Project.

Most areas within the study corridor would experience "user benefits" under the Build Alternatives compared to No Build conditions due to a reduction in transit travel times.

As shown in Figure 3-7, there would be substantial travel-time savings for communities with high concentrations of transit-dependent households. In addition, several markets estimated to experience major user benefits would not be located on the guideway. These include Waikīkī, UH Mānoa, and 'Ewa. The Build Alternatives would result in benefits to users in these areas because residents could access the guideway via local bus service or park-and-rides. With travel-time savings between planned population and employment areas and for transit-dependent households, the Project supports each of the four goals.

3.4.3 Effects on Streets and Highways

This section presents the effects that the Build Alternatives would have on traffic. It focuses on the following:

- Changes in peak-hour traffic volumes at selected screenlines
- Effects on traffic from placing columns to support the fixed guideway structure
- Effects on traffic and parking near fixed guideway stations and the potential maintenance and storage facility

Screenline Volumes and Operating Conditions

To determine the effects of the Project, street and highway system peak-period traffic volumes were evaluated at key screenline locations in the study corridor (Figure 3-4). The Salt Lake Alternative was used as the representative Build Alternative for the purpose of the screenline volume analysis. Table 3-20 compares the No Build Alternative traffic volumes for a.m. and p.m. peak hours to those of the Salt Lake Alternative. Screenlines A and H were not included because they are beyond the ends of the Project. Traffic volumes at most screenlines would decrease compared to the No Build Alternative. Peak-hour/peak-direction traffic-volume would decrease by as much as 12 percent. Traffic reductions would result from people choosing to use transit during peak travel times.

Effects of Guideway on Traffic

Columns to support the fixed guideway would be placed to minimize effects on traffic patterns. In some cases, widening the median to accommodate columns would require reducing lane widths slightly. In almost all cases, there would be no reduction in the number of roadway lanes. These effects are summarized in Table 3-21.

There is only one location along the alignment where roadway capacity would be reduced by placement of the fixed guideway structure: Salt Lake Boulevard between Marshall Road/Pakini Street and Luapele Drive in the 'Ewa-bound direction. To determine the potential effect of this change in roadway capacity, four intersections were studied:

- Salt Lake Boulevard and Kahuapa'ani Street
- Salt Lake Boulevard and Luapele Drive
- Salt Lake Boulevard and Ala'oli Street

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- Building new parking facilities in affected areas
- Developing off-street parking management programs with retail centers to minimize on-street spillover demand

3.5 Construction-related Effects on Transportation

This section focuses on short-term, construction-related effects on transportation from the Build Alternatives. Section 4.16, Construction Phase Effects, discusses construction-related effects on the natural and built environments. These effects would be temporary and would occur between 2009 and 2018 at various times and locations in the study corridor.

The Project would be opened to the public as construction phases are completed, and there would be temporary effects on transportation in station areas in the interim between the opening of each phase and project completion. These short-term effects would be primarily transit-related as bus routes are changed to complement the fixed guideway service.

3.5.1 Construction Staging Plans

Construction staging areas and plans would be identified and developed by the contractors and approved by the City. Specific details would be developed and reviewed with the relevant authorities and approvals sought. These details would include, but are not limited to, specific permitted lane closures or road closures, hours of operation, penalties for extending beyond permitted hours, and holiday restrictions. The maintenance and storage facility, park-and-ride lots, and stations could be used for construction staging areas. These areas would be sufficient for the first construction phase. Additional areas would be identified by the contractor as needed for later phases. The contractor would be responsible for obtaining any necessary permits and approvals. Additional construction and staging areas identified and requested by the contractor would be reviewed and approved by the City. Staging areas are not expected to cause a substantial effect.

3.5.2 Construction-related Effects on Transit Service

Local access to transit would be affected by lane closures within the construction corridor. Bus routes would generally be maintained but could be temporarily diverted or relocated to provide reliable service near areas where the fixed guideway would be constructed. Bus stops could also be temporarily relocated, particularly if a street's right lane is closed for construction. TheHandi-Van service would be affected similar to general traffic.

Existing bus routes were examined to determine the degree of effect during construction. Effects were classified as none, minor, and/or direct. Minor effects would occur when a route intersects and crosses a street with construction activity or traverses a short section of a construction zone. Direct effects would occur where a transit route travels along a considerable length of the construction zone. Table 3-25 lists the bus routes that would be affected by construction. Since some bus routes would pass through multiple parts of the construction corridor, they may experience both minor and direct effects, depending on location. In addition to the TheBus routes operating near the fixed guideway alignment, construction would affect TheHandi-Van operations. A Transit

Table 3-25 Bus Routes Affected by Construction

Minor Effects	Direct Effects
1, 2, 5, 7, 10, 11, 13, 17, 18, 31, 40, 40A, 44, 74, 83A, 86, 86A, 93A, 95, 201, 202, 413, 415, B, F11, F12, F13	2, 3 4, 6, 8, 9, 11, 13, 19, 20, 22, 23, 31, 32, 40, 40A, 42, 43, 52, 53, 54, 55, 56, 57, 57A, 62, 65, 71, 73, 88, 88A, 98A, 201, 202, 203, 434 , A, B, C, E, F2, F3

Balanced cantilever construction likely would be used for the longer spans crossing the H-1 and H-2 Freeways and possibly Fort Weaver Road. Individual lanes would be closed to allow this work to be completed without a full roadway closure. A detailed schedule showing which lanes would be affected would be prepared for the erection of segments. The actual means and methods for erecting these segments would be the contractor's decision. Construction with segmented precast sections would avoid the need for substantial shoring or false work. Appendix C, Construction Approach, describes the general construction process and methods likely to be used to construct the Project. Phased opening of the Project to the public would have only minor effects on traffic. This would be limited to the station areas where bus transit service has been temporarily altered to complement the interim configuration of the fixed-guideway service.

3.5.4 Construction-related Effects on Parking

In general, on-street parking would be temporarily affected by construction. Table 3-27 identifies on-street parking spaces that would be temporarily unavailable at various points along the alignment.

Some parking lots adjacent to the fixed guideway alignment could also be affected. Construction vehicle parking would occur in staging areas or on site. The contractor would determine the precise effects on parking during construction.

3.5.5 Construction-related Effects on Bicycle and Pedestrian Facilities

Access to existing bicycle and pedestrian facilities would be maintained during all phases of construction as safety allows. Warning and/or notification signs of modification to bicycle and pedestrian facilities during construction would be provided. Proposed pedestrian detours would be submitted to the City for review and approval to ensure they are reasonable for all pedestrians and meet ADA regulations. Proper deterrents, such as barriers or fencing, would be placed to prevent access (shortcuts) through the construction area.

Effects would occur in these areas as a result of the proximity of sidewalks to the roadway median. Many crossings would be temporarily eliminated, and disruptions would occur along adjacent sidewalks and bike paths. Sidewalk diversions would be made when necessary. In areas where additional right-of-way may be required (e.g., Dillingham Boulevard), sidewalks may be temporarily removed and pedestrians rerouted to safe locations.

The Transportation Technical Report (RTD 2008a) identifies potential conflicts or physical effects on existing and proposed bicycle facilities and the pedestrian circulation system that would result from construction of the Project.

3.5.6 Construction-related Effects on Freight Movement

The fixed guideway would be built along several roadways that are heavily used freight routes. Construction effects on freight could occur, especially during off-peak hours. Freight movement may be delayed by the need to use an alternative route. Loading zones along the route could be temporarily relocated.

3.5.7 Mitigation of Construction-related Effects

A Maintenance of Traffic (MOT) Plan and Transit Mitigation Program (TMP) would be the primary sources of mitigation measures identified for temporary construction-related effects on transportation.

The MOT Plan would address effects on streets and highways, transit, businesses and residences, pedestrians and bicyclists, and parking. Coordination with TheBus would identify additional bus service to mitigate construction effects. Construction methods identified by each contractor would be included in the MOT Plan. The TMP

Table 3-27 Construction-related Parking Reductions

Roadway Name	Cross Street From	Cross Street To	On- Street Parking Temporarily Lost During Construction
Common to All Build Alternatives			
Moloalo Place	Waipahu Depot Street	Mokuola Street	5
Ka`aahi Street	Dillingham Boulevard	Iwilei Road	17
Halekauwila Street	Punchbowl Street	South Street	21
Halekauwila Street	South Street	Keawe Street	15
Halekauwila Street	Keawe Street	Coral Street	38
Halekauwila Street	Coral Street	Cooke Street	10
Halekauwila Street	Cooke Street	Kamani Street	44
Halekauwila Street	Kamani Street	Ward Avenue	9
Queen Street	Ward Avenue	Kamake`e Street	46
Queen Street Extension	Kamake`e Street	Waimanu Street	21
Kona Street	Pensacola Street	Pi`ikoi Street	92
Salt Lake Alternative and Airport & Salt Lake Alternative			
Salt Lake Boulevard	Lawehana Street	Maluna Street	17
Pūkōloa Street	Māpunapuna Street	Ahua Street	38

would mitigate effects on transit service operating during project construction. These plans would be developed by the contractor for each phase and coordinated/approved by HDOT (for the MOT Plan and HDOT highways only) and the City prior to starting construction in an area.

Construction-related transportation effects would be mitigated with a Maintenance of Traffic Plan and a Transit Mitigation Program to be prepared by the contractor prior to construction.

The MOT Plan and TMP would include site-specific traffic-control measures and would be developed in conjunction with the transit system's final design. The key objectives of these plans would be to limit effects on existing traffic and maintain access to businesses. These plans would be shared with the public.

Maintenance of Traffic Plan

The following sections discuss measures included in the MOT Plan that would help mitigate construction-related transportation effects. The contractor would be given parameters, such as the number of lanes that could be closed and the procedures for closures, and would develop the MOT plan accordingly with approval from the City or HDOT. The MOT plan would address roadway closures for streets identified in Table 3-26. The Plan would specifically account for the effect of drilled shaft installation, crane access and operations, and the delivery and operation of materials trucks. The MOT Plan would also address the delivery and unloading of pre-cast guideway sections, including crane positioning for unloading. The contractor would submit any proposed changes to the MOT Plan to the City for approval.

Streets and Highways

Construction would be phased so that the duration of pile, caisson, and column work (which have the largest effect on traffic) would be minimized. During final design, whether under design-build or design-bid-build, detailed Work Zone Traffic Control Plans, including detour plans, would be formulated in cooperation with the City, HDOT, and other affected jurisdictions.

Unless unforeseen circumstances dictate, no designated major or secondary highway would be closed to vehicular or pedestrian traffic. In areas where the roadway is more than three lanes wide, no roadways would be completely closed so vehicular or pedestrian access to residences, businesses, or other establishments would still be provided. Temporary lane closures would occur during non-peak hours so that effects on heavy commuter traffic would be minimized.

Delivery of large equipment, such as drilling devices, cranes, and launching gantry truss sections, would occur along arterial routes to the construction corridor. City and HDOT approvals would be sought for proposed haul routes and included in the contract packages.

An extensive public information program would be implemented to provide motorists with a thorough understanding of the location and duration of construction activities, as well as anticipated traffic conditions. The MOT Plan would also address traffic signal changes and relocation of freight loading zones that might be temporarily affected.

Transit

The MOT Plan would determine when and where changes in bus services could be needed and would include Transportation Demand Management elements. The Project would be integrated with TheBus on potential changes to bus routes and service. Changes in bus service could include improving frequencies on existing routes or adding new routes that circumvent specific construction areas.

Pedestrians and Bicycles

Pedestrian and bicycle access would be maintained during construction as much as possible while emphasizing safety. Measures to maintain safe and efficient pedestrian and bicycle access would meet ADA regulations and could include the following:

- Channelizing pedestrian flow in areas where sidewalks would be close to construction—channelized structures are generally steel-framed, three-sided plywood structures built above existing sidewalks
- Making extensive use of signage to direct pedestrians and bicyclists to the safest and most efficient routes through construction zones—signs would warn pedestrians and bicyclists well in advance of sidewalk and bike lane closures

Parking

The MOT would consider potential measures to replace parking spaces that would be temporarily lost during construction. These measures could include the possible lease of off-street spaces to address this temporary loss. A temporary loading zone relocation plan would also be included.

Construction Phasing

The Build Alternatives would be constructed in phases. For example, the Airport & Salt Lake Alternative could be phased so that the guideway between East Kapolei and Ala Moana Center along Salt Lake Boulevard would be built first, followed by a connection from Middle Street Transit Center to the Honolulu International Airport. The connection from the airport to Aloha Stadium could be completed as the final phase of the Project when additional funds become available.

The choice of phasing would not affect construction methods, but would affect the areas that would be disturbed at any specific time. The MOT